Indiana
DEPARTMENT OF EDUCATION
Dr. Jennifer McCormick
Superintendent of Public Instruction
Working Together for Student Success

Science and Engineering Process Standards (SEPS)
The Science and Engineering Process Standards are the processes and skills that students are expected to learn and be able to do within the context of the science content. The separation of the Science and Engineering Process Standards from the Content Standards is intentional; the separation of the standards explicitly shows that what students are doing while learning science is extremely important. The Process Standards reflect the way in which students are learning and doing science and are designed to work in tandem with the science content, resulting in robust instructional practice.

Science and Engineering Process Standards		Content Connectors
SEPS.1 Posing questions (for science) and defining problems (for engineering)	A practice of science is posing and refining questions that lead to descriptions and explanations of how the natural and designed world(s) work and these questions can be scientifically tested. Engineering questions clarify problems to determine criteria for possible solutions and identify constraints to solve problems about the designed world.	A practice of science is posing and refining questions that lead to descriptions and explanations of how the natural and designed world(s) work and these questions can be scientifically tested. Engineering questions clarify problems to determine criteria for possible solutions and identify constraints to solve problems about the designed world.

SEPS.2 Developing and using models and tools	A practice of both science and engineering is to use and construct conceptual models that illustrate ideas and explanations. Models are used to develop questions, predictions and explanations; analyze and identify flaws in systems; build and revise scientific explanations and proposed engineered systems; and communicate ideas. Measurements and observations are used to revise and improve models and designs. Models include, but are not limited to: diagrams, drawings, physical replicas, mathematical representations, analogies, and other technological models. Another practice of both science and engineering is to identify and correctly use tools to construct, obtain, and evaluate questions and problems. Utilize appropriate tools while identifying their limitations. Tools include, but are not limited to: pencil and paper, models, ruler, a protractor, a calculator, laboratory equipment, safety gear, a spreadsheet, experiment data collection software, and other technological tools.	A practice of both science and engineering is to use and construct conceptual models that illustrate ideas and explanations. Models are used to develop questions, predictions and explanations; analyze and identify flaws in systems; build and revise scientific explanations and proposed engineered systems; and communicate ideas. Measurements and observations are used to revise and improve models and designs. Models include, but are not limited to: diagrams, drawings, physical replicas, mathematical representations, analogies, and other technological models. Another practice of both science and engineering is to identify and correctly use tools to construct, obtain, and evaluate questions and problems. Utilize appropriate tools while identifying their limitations. Tools include, but are not limited to: pencil and paper, models, ruler, a protractor, a calculator, laboratory equipment, safety gear, a spreadsheet, experiment data collection software, and other technological tools.

SEPS.3 Constructing and performing investigations	Scientists and engineers are constructing and performing investigations in the field or laboratory, working collaboratively as well as individually. Researching analogous problems in order to gain insight into possible solutions allows them to make conjectures about the form and meaning of the solution. A plan to a solution pathway is developed prior to constructing and performing investigations. Constructing investigations systematically encompasses identified variables and parameters generating quality data. While performing, scientists and engineers monitor and record progress. After performing, they evaluate to make changes to modify and repeat the investigation if necessary.	Scientists and engineers are constructing and performing investigations in the field or laboratory, working collaboratively as well as individually. Researching analogous problems in order to gain insight into possible solutions allows them to make conjectures about the form and meaning of the solution. A plan to a solution pathway is developed prior to constructing and performing investigations. Constructing investigations systematically encompasses identified variables and parameters generating quality data. While performing, scientists and engineers monitor and record progress. After performing, they evaluate to make changes to modify and repeat the investigation if necessary.
SEPS.4 Analyzing and interpreting data	Investigations produce data that must be analyzed in order to derive meaning. Because data patterns and trends are not always obvious, scientists and engineers use a range of tools to identify the significant features in the data. They identify sources of error in the investigations and calculate the degree of certainty in the results. Advances in science and engineering makes analysis of proposed solutions more efficient and effective. They analyze their results by continually asking themselves questions; possible questions may be, but are not limited to: “Does this make sense?” "Could my results be duplicated?" and/or “Does the design solve the problem with the given constraints?”	Investigations produce data that must be analyzed in order to derive meaning. Because data patterns and trends are not always obvious, scientists and engineers use a range of tools to identify the significant features in the data. They identify sources of error in the investigations and calculate the degree of certainty in the results. Advances in science and engineering makes analysis of proposed solutions more efficient and effective. They analyze their results by continually asking themselves questions; possible questions may be, but are not limited to: “Does this make sense?” "Could my results be duplicated?" and/or “Does the design solve the problem with the given constraints?”

SEPS.5 Using mathematics and computational thinking	In both science and engineering, mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used for a range of tasks such as constructing simulations; solving equations exactly or approximately; and recognizing, expressing, and applying quantitative relationships. Mathematical and computational approaches enable scientists and engineers to predict the behavior of systems and test the validity of such predictions. Scientists and engineers understand how mathematical ideas interconnect and build on one another to produce a coherent whole.	In both science and engineering, mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used for a range of tasks such as constructing simulations; solving equations exactly or approximately; and recognizing, expressing, and applying quantitative relationships. Mathematical and computational approaches enable scientists and engineers to predict the behavior of systems and test the validity of such predictions. Scientists and engineers understand how mathematical ideas interconnect and build on one another to produce a coherent whole.
SEPS.6 Constructing explanations (for science) and designing solutions (for engineering)	Scientists and engineers use their results from the investigation in constructing descriptions and explanations, citing the interpretation of data, connecting the investigation to how the natural and designed world(s) work. They construct or design logical coherent explanations or solutions of phenomena that incorporate their understanding of science and/or engineering or a model that represents it, and are consistent with the available evidence.	Scientists and engineers use their results from the investigation in constructing descriptions and explanations, citing the interpretation of data, connecting the investigation to how the natural and designed world(s) work. They construct or design logical coherent explanations or solutions of phenomena that incorporate their understanding of science and/or engineering or a model that represents it, and are consistent with the available evidence.

SEPS.7 Engaging in argument from evidence	Scientists and engineers use reasoning and argument based on evidence to identify the best explanation for a natural phenomenon or the best solution to a design problem. Scientists and engineers use argumentation, the process by which evidence-based conclusions and solutions are reached, to listen to, compare, and evaluate competing ideas and methods based on merits. Scientists and engineers engage in argumentation when investigating a phenomenon, testing a design solution, resolving questions about measurements, building data models, and using evidence to evaluate claims.	Scientists and engineers use reasoning and argument based on evidence to identify the best explanation for a natural phenomenon or the best solution to a design problem. Scientists and engineers use argumentation, the process by which evidence-based conclusions and solutions are reached, to listen to, compare, and evaluate competing ideas and methods based on merits. Scientists and engineers engage in argumentation when investigating a phenomenon, testing a design solution, resolving questions about measurements, building data models, and using evidence to evaluate claims.
SEPS.8 Obtaining, evaluating, and communicating information	Scientists and engineers need to be communicating clearly and articulating the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity. Communicating information and ideas can be done in multiple ways: using tables, diagrams, graphs, models, and equations, as well as, orally, in writing, and through extended discussions. Scientists and engineers employ multiple sources to obtain information that is used to evaluate the merit and validity of claims, methods, and designs.	Scientists and engineers need to be communicating clearly and articulating the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity. Communicating information and ideas can be done in multiple ways: using tables, diagrams, graphs, models, and equations, as well as, orally, in writing, and through extended discussions. Scientists and engineers employ multiple sources to obtain information that is used to evaluate the merit and validity of claims, methods, and designs.

Content Standards
For the high school science courses, the content standards are organized around the core ideas in each particular course. Within each core idea are indicators which serve as the more detailed expectations within each of the content areas.

Indiana Environmental Science	Content Connectors

Standard 1: Environmental Systems	**Env.1.1** Understand and explain that ecosystems have cyclic fluctuations, such as seasonal changes or changes in population, as a result of migration, birth, and mortality.	**Env.1.1.a.1** Understand and explain that ecosystems have cyclic fluctuations, such as seasonal changes or changes in population, as a result of migration, birth, and mortality.
	Env.1.2 Understand and explain that human beings are part of Earth's ecosystems and give examples of how human activities can, deliberately or inadvertently, alter ecosystems.	**Env.1.2.a.1** Understand and explain that human beings are part of Earth's ecosystems and give examples of how human activities can, deliberately or inadvertently, alter ecosystems.
	Env.1.3 Recognize and describe the difference between systems in equilibrium and systems in disequilibrium. Describe how steady state is achieved through negative and positive feedback loops.	**Env.1.3.a.1** Recognize and describe the difference between systems in equilibrium and systems in disequilibrium. Describe how steady state is achieved through negative and positive feedback loops.
	Env.1.4 Diagram the cycling of carbon, nitrogen, phosphorus, and water and describe the human impacts on each.	**Env.1.4.a.1** Diagram the cycling of carbon, nitrogen, phosphorus, and water and describe the human impacts on each.
	Env.1.5 Identify and measure biological, chemical, and physical (abiotic and biotic) factors within an ecosystem.	**Env.1.5.a.1** Identify and measure biological, chemical, and physical (abiotic and biotic) factors within an ecosystem.
	Env.1.6 Describe the difference between weather and climate. Locate, identify, and describe the major Earth biomes. Explain how biomes are determined by climate (temperature and precipitation patterns) that support specific kinds of plants.	**Env.1.6.a.1** Describe the difference between weather and climate. **Env.1.6.a.2** Locate, identify, and describe the major Earth biomes. Explain how biomes are determined by climate (temperature and precipitation patterns) that support specific kinds of plants.
	Env.1.7 Identify tools and technologies used to adapt and alter environments and natural resources in order to meet human physical and cultural needs.	**Env.1.7.a.1** Identify tools and technologies used to adapt and alter environments and natural resources in order to meet human physical and cultural needs.
	Env.1.8 Explain the factors that influence weather and climate, the action of gravitational forces, and the rotation of the Earth.	**Env.1.8.a.1** Explain the factors that influence weather and climate, the action of gravitational forces, and the rotation of the Earth.

	Env.1.9 Describe how weather can be influenced by global climatic patterns, such as El Niño and La Niña.	**Env.1.9.a.1** Describe how weather can be influenced by global climatic patterns, such as El Niño and La Niña.

Standard 2: Flow of Matter and Energy	**Env.2.1** Describe how matter cycles through sources and sinks and how energy is transferred. Explain how matter and energy move between and within components of an environmental system.	**Env.2.1.a.1** Describe how matter cycles through sources and sinks and how energy is transferred. Explain how matter and energy move between and within components of an environmental system.
	Env.2.2 Identify the different forms of energy and understand that energy may be converted from one form to another, but cannot be created or destroyed.	**Env.2.2.a.1** Identify the different forms of energy and understand that energy may be converted from one form to another, but cannot be created or destroyed.
	Env.2.3 Recognize and explain that the amount of life any environment can support is limited by the available energy, water, oxygen, nutrients and minerals, and by the ability of ecosystems to recycle organic materials from the remains of dead organisms.	**Env.2.3.a.1** Recognize and explain that the amount of life any environment can support is limited by the available energy, water, oxygen, nutrients and minerals, and by the ability of ecosystems to recycle organic materials from the remains of dead organisms.
	Env.2.4 Recognize and describe the different sources of energy, including fossil fuels, nuclear, and alternative sources of energy provided by water, wind, geothermal, biomass/biofuels, and the sun.	**Env.2.4.a.1** Recognize and describe the different sources of energy, including fossil fuels, nuclear, and alternative sources of energy provided by water, wind, geothermal, biomass/biofuels, and the sun.
	Env.2.5 Give examples of the various forms and uses of fossil fuels and nuclear energy in our society.	**Env.2.5.a.1** Give examples of the various forms and uses of fossil fuels and nuclear energy in our society.
	Env.2.6 Understand and describe how layers of energy-rich organic material have been gradually turned into great coal beds and oil pools by the pressure of the overlying earth. Recognize that by burning these fossil fuels, people are passing stored energy back into the environment as heat and releasing large amounts of matter such as carbon dioxide and other air pollutants.	**Env.2.6.a.1** Understand and describe how layers of energy-rich organic material have been gradually turned into great coal beds and oil pools by the pressure of the overlying earth. Recognize that by burning these fossil fuels, people are passing stored energy back into the environment as heat and releasing large amounts of matter such as carbon dioxide and other air pollutants.

	Env.2.7 Differentiate between renewable and nonrenewable resources, and compare and contrast the pros and cons of using nonrenewable resources.	**Env.2.7.a.1** Differentiate between renewable and nonrenewable resources.
		Env.2.7.a.2 Compare and contrast the pros and cons of using nonrenewable resources.
	Env.2.8 Cite examples of how all fuels, renewable and nonrenewable, have advantages and disadvantages that society must question when considering the trade-offs among them, such as how energy use contributes to the rising standard of living in the industrially developing nations. However, explain that this energy use also leads to more rapid depletion of Earth's energy resources and to environmental risks associated with the use of fossil and nuclear fuels.	**Env.2.8.a.1** Cite examples of how all fuels, renewable and nonrenewable, have advantages and disadvantages that society must question when considering the trade-offs among them, such as how energy use contributes to the rising standard of living in the industrially developing nations. However, explain that this energy use also leads to more rapid depletion of Earth's energy resources and to environmental risks associated with the use of fossil and nuclear fuels.
	Env.2.9 Describe how decisions to slow the depletion of energy sources through efficient technologies can be made at many levels, from personal to national, and these technologies involve trade-offs of economic costs and social values.	**Env.2.9.a.1** Describe how decisions to slow the depletion of energy sources through efficient technologies can be made at many levels, from personal to national, and these technologies involve trade-offs of economic costs and social values.
	Env.2.10 Understand and describe how nuclear reactions release energy without the combustion products of burning fuels, but that the radioactivity of fuels and by-products poses other risks which may last for thousands of years. Understand and assess the uses of nuclear fission and fusion, including the implications for society.	**Env.2.10.a.1** Understand and describe how nuclear reactions release energy without the combustion products of burning fuels, but that the radioactivity of fuels and by-products poses other risks which may last for thousands of years.
		Env.2.10.a.2 Understand and assess the uses of nuclear fission and fusion, including the implications for society.
	Env.2.11 Recognize and describe the role of natural resources in providing the raw materials for an industrial society.	**Env.2.11.a.1** Recognize and describe the role of natural resources in providing the raw materials for an industrial society.

Standard 3: Natural Disasters	**Env.3.1** Identify and describe geomorphic processes controlled by tectonics (i.e. volcanic activity, uplift, and shaping of landforms).	**Env.3.1.a.1** Identify and describe geomorphic processes controlled by tectonics (i.e. volcanic activity, uplift, and shaping of landforms).
	Env.3.2 Identify and describe tornado formation with the use of a weather map.	**Env.3.2.a.1** Identify and describe tornado formation with the use of a weather map.
	Env.3.3 Read and describe a weather map in terms of pressure systems, fronts, and changing weather patterns.	**Env.3.3.a.1** Read and describe a weather map in terms of pressure systems, fronts, and changing weather patterns.
	Env.3.4 Identify natural Earth hazards, such as earthquakes and hurricanes, and identify the regions in which they occur as well as the short-term and long-term effects on the environment and on people.	**Env.3.4.a.1** Identify natural Earth hazards, such as earthquakes and hurricanes, and identify the regions in which they occur as well as the short-term and long-term effects on the environment and on people.
Standard 4: Environmental Policy	**Env.4.1** Explain environmental policies/ organizations (Clean Water Act, Clean Air Act, Endangered Species Act, Species Survival Plan, Resource Conservation and Recovery Act, Department of Energy, and the World Health Organization) and identify their impact.	**Env.4.1.a.1** Explain environmental policies/ organizations (Clean Water Act, Clean Air Act, Endangered Species Act, Species Survival Plan, Resource Conservation and Recovery Act, Department of Energy, and the World Health Organization) and identify their impact.
	Env.4.2 Understand that environmental policies/decisions have negative and positive impacts on people, societies, and the environment.	**Env.4.2.a.1** Understand that environmental policies/decisions have negative and positive impacts on people, societies, and the environment.
Standard 5: Biodiversity	**Env.5.1** Explain how variation within a species increases the chances of survival of the species under changing environmental conditions.	**Env.5.1.a.1** Explain how variation within a species increases the chances of survival of the species under changing environmental conditions.
	Env.5.2 Explain how the great diversity of species increases the chance that at least some living organisms will survive in the event of major global changes.	**Env.5.2.a.1** Explain how the great diversity of species increases the chance that at least some living organisms will survive in the event of major global changes.

	Env.5.3 Explain genetic engineering and identify implications on the environment and society.	**Env.5.3.a.1** Explain genetic engineering and identify implications on the environment and society.
	Env.5.4 Describe, provide examples, and contrast GMO products, organic products, and conventional products. Describe and explain the environmental concerns associated with GMOs.	**Env.5.4.a.1** Describe, provide examples, and contrast GMO products, organic products, and conventional products.
		Env.5.4.a.2 Describe and explain the environmental concerns associated with GMOs.
	Env.5.5 Identify the indirect and direct threats to biodiversity (e.g. habitat loss and destruction, invasion by exotic species, commercial over fishing and hunting, pollution, climate change, and bioaccumulation and biomagnification of toxins).	**Env.5.5.a.1** Identify the indirect and direct threats to biodiversity (e.g. habitat loss and destruction, invasion by exotic species, commercial over fishing and hunting, pollution, climate change, and bioaccumulation and biomagnification of toxins).
	Env.5.6 Identify and explain the three levels of biodiversity: genetic, species, and ecosystem.	**Env.5.6.a.1** Identify and explain the three levels of biodiversity: genetic, species, and ecosystem.

Standard 6: Population	**Env.6.1** Demonstrate, calculate, and explain how factors such as birth rate, death rate, and migration rate determine growth rates of populations.	**Env.6.1.a.1** Demonstrate, calculate, and explain how factors such as birth rate, death rate, and migration rate determine growth rates of populations.
	Env.6.2 Explain how the size and rate of growth of the human population in any location is affected by economic, political, religious, technological, and environmental (resource availability) factors.	**Env.6.2.a.1** Explain how the size and rate of growth of the human population in any location is affected by economic, political, religious, technological, and environmental (resource availability) factors.
	Env.6.3 Describe and give examples about how the decisions of one generation both provide and limit the range of possibilities open to the next generation.	**Env.6.3.a.1** Describe and give examples about how the decisions of one generation both provide and limit the range of possibilities open to the next generation.
	Env.6.4 Explain how the carrying capacity of an ecosystem may change as availability of resources changes.	**Env.6.4.a.1** Explain how the carrying capacity of an ecosystem may change as availability of resources changes.

Standard 7: Pollution	**Env.7.1** Identify evidence, consequences, and prevention for climate change produced by anthropogenic sources.	**Env.7.1.a.1** Identify evidence, consequences, and prevention for climate change produced by anthropogenic sources.
	Env.7.2 Differentiate between natural pollution and pollution caused by humans.	**Env.7.2.a1** Differentiate between natural pollution and pollution caused by humans.
	Env.7.3 Compare and contrast the effects of environmental stressors (i.e. herbicides, pesticides) on plants and animals. Give examples of secondary effects on other environmental components.	**Env.7.3.a.1** Compare and contrast the effects of environmental stressors (i.e. herbicides, pesticides) on plants and animals. Give examples of secondary effects on other environmental components.
	Env.7.4 Explain what common household toxins are, what to do in an emergency, and how to properly dispose.	**Env.7.4.a.1** Explain what common household toxins are, what to do in an emergency, and how to properly dispose.
	Env.7.5 Identify and describe the major air pollutants and their sources and impacts on the environment and human health.	**Env.7.5.a.1** Identify and describe the major air pollutants and their sources and impacts on the environment and human health.
	Env.7.6 Understand and explain how the burning of fossil fuels releases energy, waste heat, and matter (air pollutants).	**Env.7.6.a.1** Understand and explain how the burning of fossil fuels releases energy, waste heat, and matter (air pollutants).
	Env.7.7 Describe and explain the product life cycle and waste stream and its implications to waste management. Explain the difference between reduce, reuse, and recycle.	**Env.7.7.a.1** Describe and explain the product life cycle and waste stream and its implications to waste management. Explain the difference between reduce, reuse, and recycle.

Standard 8: Natural and Anthropogenic	**Env.8.1** Demonstrate a knowledge of the distribution of natural resources in the U.S. and the world, and explain how natural resources influence relationships among nations.	**Env.8.1.a.1** Demonstrate a knowledge of the distribution of natural resources in the U.S. and the world.
		Env.8.1.a.2 Explain how natural resources influence relationships among nations.

	Env.8.2 Understand and describe the concept of integrated natural resource management and the values of managing natural resources as an ecological unit.	**Env.8.2.a.1** Understand and describe the concept of integrated natural resource management and the values of managing natural resources as an ecological unit.
	Env.8.3 Recognize and explain that in evolutionary change, the present arises from the materials of the past and in ways that can be explained, such as the formation of soil from rocks and dead organic matter.	**Env.8.3.a.1** Recognize and explain that in evolutionary change, the present arises from the materials of the past and in ways that can be explained, such as the formation of soil from rocks and dead organic matter.
	Env.8.4 Describe how agricultural technology requires trade-offs between increased production and environmental harm and between efficient production and social values.	**Env.8.4.a.1** Describe how agricultural technology requires trade-offs between increased production and environmental harm and between efficient production and social values.
	Env.8.5 Describe and examine how water is controlled in developed and undeveloped nations.	**Env.8.5.a.1** Describe and examine how water is controlled in developed nations.
		Env.8.5.a.2 Describe and examine how water is controlled in undeveloped nations.
	Env.8.6 Understand and describe the concept and the importance of natural and human recycling in conserving our natural resources.	**Env.8.6.a.1** Understand and describe the concept and the importance of natural and human recycling in conserving our natural resources.
	Env.8.7 Understand and explain that waste management includes considerations of quantity, safety, degradability, and cost. Also understand that waste management requires social and technological innovations because waste-disposal problems are political and economic as well as technical.	**Env.8.7.a.1** Understand and explain that waste management includes considerations of quantity, safety, degradability, and cost. Also understand that waste management requires social and technological innovations because waste-disposal problems are political and economic as well as technical.